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EXPERIMENTAL WORK

OF THE

HORTICULTURAL DEPARTMENT

OF THE

Colorado Agricultural College,

FORT COLLINS, COLORADO.

1886.

Colorado. Agricultural and
" Mechanical College, Fort Collins
Horticultural Dept.

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FORT COLLINS, COLO.:
The Courier Book and Job Print.
1886.

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VF May 28, 56

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INTRODUCTORY.

I herewith submit my third annual report of experiments in Botany and Horticulture, the nature and purpose of which are amply set forth in the report for 1884, which shows the importance and value of careful experiments in this State, and the necessity that exists for their continuance over a series of years.

While the season has, on the whole, not been without its disappointments and accidents, still the comparative absence of insect foes, and the ability we possess in the possession of water to keep our plants doing their best at all times, forces upon us the great advantages of Colorado as an agricultural State, and as a field for experimental work that will, it is hoped, prove of some value to the people of our State.

Certainly our checkered experience in the culture of fruit and forest trees would suggest to us forcibly enough the necessity of selecting only such kinds as are hardy, do not start too early in spring, and that make a definite annual growth.

James Cassidy,
Professor of Horticulture.

Colorado Agricultural College, 1886.

By Transfer
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HORTICULTURAL DEPARTMENT.

EXPERIMENTS WITH POTATOES.

The potatoes in this comparative test of varieties were cut to one eye each, discarding the seed end.

The soil was put in excellent tilth and fertility, by frequent working and manuring. The rows were laid off three feet apart, and the earth removed to a depth of six inches; in the bottom of the trenches was placed a compost of well decayed stable manure and coal ashes to a depth of three inches, on which the sets were placed one foot apart; the trenches were then filled to one inch above the surface and raked smooth.

The potato crop has become one of great importance to American farmers; the product, in favorable seasons, is well on to 200,000,000 bushels: the demand, too, is steady and growing, especially wherever the soil is particularly adapted to its production. Of the varieties now cultivated many are so highly meritorious that it would seem to be well nigh impossible to improve on them. We are far from thinking, however, that sufficient care is exercised in fixing the good qualities so necessary in every candidate for public approval. Many of the so-called crosses are really the result of chance, the grower has had but little to do with the origination of the variety; such important features of a perfect potato, as a medium top, prolificacy of yield, closeness in the hill and good flavor, are the result of chance. The objection we have to some of the newer varieties of the potato is that this tuber bearing habit is not sufficiently fixed. In adverse seasons, or under other unfavorable conditions,as those of soil or of climate, as on being grown in Europe or in widely distant parts of our own country, they fail to retain their good qualities for any length of time.

The claim of best for each new kind is generally not without reason, for some varieties do better under certain conditions than others, and others again seem to have their peculiarities so well fixed as not to be seriously affected by the most adverse conditions. There are probably some soils, too, in which the potato deteriorates, or like some fruits, they are adapted only to the surroundings in which they originated; this would seem to be the case with the Neshannock, once a great favorite on the plains, but now seeming to have lost the tuber bearing faculty, except when grown in the mountains at high elevations.

All of the varieties flowered, but only the coarse topped, late tuber developing kinds, bore seed, for the reason, I imagine, that some varieties seem to be bred to make tubers early in their growth, and only a moderate top and no seed, as in the Early Rose, although, doubtless, the latter could be induced to furnish an abundance of seed by removing the tubers as they formed—as the late Mr. Knight did. While others, as the Ruby, and Compton Surprise, every year bear an abundance of seed balls, and a very coarse top, but have not the tuber bearing faculty very strongly developed, nor are their tubers borne sufficiently close in the hill to realize one's ideal of the perfect potato. We regard these berry-bearing kinds, for the circumstances under which they are grown here, as seriously impairing their value, as we believe them to be born at the expense of tubers. Tuber bearing is not the chief function of many of the *Solanums* and hence perhaps the tendency to running to top seen in many varieties of the potato. We know from experience with some plants under domestication, that they, to a great extent, lose their ability to produce seed if continuously propagated for any length of time by any of the methods of division, as in the Banana, the Baldwin apple and the well established varieties of the garden verbena, which rarely produce much seed, for the reason that they are only continued by propagation from cuttings, and this continued propagation by division may be the reason why many varieties of the potato are so shy in seed bearing.

The past season cannot be called a sufficient test of the many varieties planted, owing to a blight appearing on the foliage arresting all further development of tuber for the season. Doubtless varieties that have failed this season, would, in a more favorable year, prove meritorious. Although so many kinds were a failure, and none were up to the high expectations we at one time had reason to expect, yet, on the whole, the test is a profitable one, inasmuch as it enables one to determine on what varieties to pin our faith. That the loss of stem and foliage would seriously impair the table value of the coarse-growing kinds, we expected from experience.

The chemical composition of the potato varies with the soil in which it is grown, the season, and nature of the fertilizers used. The best potatoes contain about 20 per cent. of starch; it is formed in the leaves, and hence to have good potatoes the leaves must be uninjured throughout the season of development. If they are destroyed by insects or disease the tubers must suffer in quality, as they have this season. A green or half grown potato does not contain as much starch as a ripe one, for the tuber is not at its best until the leaves and stems have deposited all of their starch in them for the perpetuation of the species.

The blight of the foliage we attribute to the exceptional warmth of the season heating the soil to an unnatural extent for this plant. For although the potato delights in a moderately cool climate, it can be grown in such as are much warmer than that in which it does best, and also in a much colder one. The roots strike down deep, where it is cool and moist, but the tubers are impatient of a soil too wet. In the mountains, at high elevation, blight is unknown, and in soils on the plains peculiarly adapted to the potato, almost perfect immunity from the disease is not unfrequently noticed. I am further led to look upon this as an inducing cause of blight by reason of the fact that the potato may be grown under mulch, even in the most unfavorable seasons, providing always that varieties are used that tuber quickly and that do not expend their vitality in growing top. The size of the top in such varieties bears an evident and definite relation to the development of tuber, and especially is this so if the seed has been cut to one eye or to two separate eyes.

Of the potato it may be truly said that it will grow in almost any kind of soil, but the soil best adapted to it, however, is loose and friable; its nature would suggest this, because the tuber must push the soil from around it in the process of growth, and if the soil be hard and lumpy the tuber will be misshapen and its vital forces seriously impaired. The tendency of all irrigation is to bind more solidly all adhesive, fine-grained soils, so that the first requisite of success as regards the soil is to see to its mechanical condition, and in the application of water that no flooding of the soil occurs, and that the water is shut off when in the judgment of the operator a sufficiency has been applied, for it is as true under irrigation as without it that soils which hold water too long and which will bake, either after rain or irrigation, are entirely unfitted for the culture of the potato. We irrigated four times, because our land is rolling and the soil stiff and adhesive, so that irrigating such land would seem much like pouring water on the back of a duck. Land more level and porous, and hence more susceptible to irrigation, has often a sufficiency in one or two waterings, and in certain cases even without any.

Flat culture, so successfully practiced at the east, would be quite inconsistent with the practice of any system of irrigation, as the potato on any soil, but especially on a stiff one, is impatient of surface watering. To grow the potato at all the soil must be ridged or furrowed to enable the water to pass along between the rows and seep from side to side but never to reach or flood the whole surface of the soil This objection will not apply with the same force to soil heavily mulched, for the reason that such land does not bake. As to the distance apart, this depends altogether on the character of the soil and the variety planted. Some kinds, especially on rich soils, and with too much water, will make excessively large tops, and must have more room than varieties bred to make tuber instead of top.

The earliest varieties were Early Kent, Early Sunrise, Alpha, Clark's No. 1, Early Harvest, Lee's Favorite and Early Ohio; all of these done well and had it not been for the blight, they would have been exceptionally fine.

Other and later kinds that were admirable were Cap Sheaf, Queen of the Valley, Winslow, Bliss' Triumph, Steuben Beauty, Wells' Seedling, Diamond, Boston Cracker, Corliss, Matchless, Rubicund, Electric Crawford's Seedling, Howard, Cayuga, Rosy morn, Boston Market, El Paso, Belle, Manhattan, Baker's Imperial, Goodrich, Beauty, Hebron and White Elephant. Many others done moderately well, and still others again were an utter failure, notably so, Rural Blush, Dakota Red, Telephone, Burbank, McCormick and many others, as will be seen by the following table:

TABLE OF EXPERIMENTS.

Variety.	Quality of Seed.	Weight of 20 hills in ℔s. and ozs.	Height in inches	Weight of five largest potatoes in ℔s. and ozs.	Weight of large potatoes in ℔s. and ozs.	Weight of small potatoes in ℔s. and ozs.	Estimated yield per acre in bushels and ℔s.
Alamo	Fair, smooth	8..4	19	1..3	2..4	6	99..50
Prairie Farmer	Large, sound	16..3	21	3..4	12	4..3	195..52
Cap Sheaf	Fine, sound	32	17	5..3	30	2	387..12
Clark's No. 1	Large, sound	17..5	22	4..2	13..3	4	209..29
Farina	Medium sound	6..3	25	1..2	1..3	5	74..52
Winslow	Large, smooth	23	20	4	19	4..6	278..18
Home Comfort	Large, smooth	4..1	27	12	1	3..1	49..09
American Magnum Bonum	Large, decaying	4	26	15	......	4	48..24
Queen Valley	Large, fine	25..1	20	4..9	22	3..1	303 15
Early Telephone	Medium	6	16	1..3	1	5	72..36
St. Patrick Wisconsin	Medium, sound	14..1	20	2..4	12	2..1	163..30
Rochester Favorite	Fine, sound	8..2	27	1..10	3	5..2	98..48
Jones' Prize Taker	Large, scabby	20..1	19	3..12	16..1	4	242..45
Knapp's Snow Bank	Large, fine	16	20	3	11	5	193..36
Dakota Red	Large, fine	10	27	2..2	5	5	121..06
Rubicund	Large, fine	24..4	19	4..5	20	4..4	293..25
Electric	Medium, sound	25	17	4..9	20	5	302..0½
Jordan's Early Russet	Large, sound	16..1	16	2..4	10	6..1	194..21
Belle (Wis.)	Medium, sound	23..2	16	2..7	19	4..2	280..10
Cook's Superb (Wis.)	Poor, sound	8	24	1..9	4	4	96..48
Manhattan	Large, decayed	24..7	20	2..11	20	4..7	295..42
Rose's Seedling (Wis.)	Large, sound	17..4	19	2..4	10	7	208..43
El Paso (Ohio)	Large, decayed	22	20	3	20	2	266..12
Defiance	Fine, decayed	12..3	25	1..2	7	5	147..28
Chicago Market	Fine, decayed	17..1	21	2	11	6	206..27
McCormick	Fine, decayed	5..2	26	1..4	1..2	4	62..22
Western Rose	Medium, decayed	8..3	21	1..2	2..3	6	99..04
Carpenter Seedling	Fair, sound	30	18	4..1	25	5	36..18
Rural Blush	Large, decayed	9..9	28	2..1	2..9	7	115..42
Carpenter's Seedling (Ohio)	Medium, sound	4..4	20	1..2	1	3..4	51..25
Crawford Seedling	Medium, sound	20	19	3..8	17	3	242
Alpha	Medium, sound	23..6	14	3..12	22..6	1..6	282..50
Carpenter Seedling (Wis.)	Medium, sound	18..2	20	2..10	10..2	8	219..40
Silver Skin	Small, decayed	8..2	22	1..4	4	4..1	98..40
Early Telephone (Wis.)	Smooth, fine	13..2	16	1..6	8	5..2	159..10
Salt Lake	Fine, sound	16..3	16	2..1	10	6	195..52
Black Stock	Extra, sound	16..1	19	2..4	7	9..1	194..21
Neshannock	Small, shrunk	6	27	12	6	6	72..86
Salt Lake Queen	Fair, sound	12	23	1..2	7	5	145..12
Conqueror	Fair, sound	10..2	24	1	5	5..2	122..52

TABLE OF EXPERIMENTS---Continued.

Variety.	Quality of Seed.	Weight of 20 hills in lbs. and ozs.	Height in inches	Weight of five largest potatoes in lbs. and ozs.	Weight of large potatoes in lbs. and ozs.	Weight of small potatoes in lbs. and ozs.	Estimated yield per acre in bushels and lbs.
Parson's Prolific	Fair, sound	12..5	22	1..10	8	4..5	148..59
Grange (Ohio)	Large, decayed	12..1	25	1..4	7	5..1	145..57
Silver Skin (Ohio)	Poor, decayed	6..3	20	11	......	6..1	74..52
State Maine	Medium,smooth,sound	10..3	24	1..10	5..3	5	123..16
Baker's Imperial	Medium,smooth,sound	19..8	20	4..2	17..8	2	235..57
Telephone (Ohio)	Medium, unsound	6	14	12	1	5	72..36
Lee's Favorite	Medium, sound	18..4	15	4..5	16	4	220..49
Extra Early Snowball	Medium, sound	4..2	14	12	......	4..1	50..16
Jordan's Prolific (Ohio)	Medium, sound	15	19	3	12	3	181..30
Belle (Wis.)	Medium, decayed	16	29	3..4	12	4	193..36
Morton White	Large, decayed	8	29	1..6	1	7	96..48
Orange County White	Medium, sound	8..3	24	1..4	2..3	6	99..04
Snow Flake	Medium, sound	18	18	3..9	4	14	217..48
Mullen	Medium, sound	7	23	2	5	2	84..42
Dundeary	Large, sound	10..4	20	2..1	5	5..4	124..01
Goodrich	Large, sound	30	17	5..4	27	3	363
Ruby	Large, sound	12	23	2..7	3	9	145..12
Beauty of Hebron	Large, sound	22	18	3..9	20	2	266..12
Seedling	Large, sound	23	17	3..9	20	3	278..18
Salt Lake Queen	Large, sound	13..4	24	2..3	5..4	8	160..19
Davy Salt Lake Seedling	Large, sound	16..3	26	2..9	6	10..3	195..52
White Elephant	Large, sound	24	25	4	4	20	290..24
Howard	Large, fair	24	17	3	22	2	290..24
Bliss Triumph	Large, fair	28..3	18	4..2	22	6	391..04
White Star	Large, fair	......	...	....	......	......	....
Cayuga	Large, fine	17..2	19	2..12	12	5	207..37
American Giant	Large, fine	12..3	26	2	5	7	147..28
Silver Skin	Large, fine	8..1	17	1..4	3	4	97..04
Duchess	Large, fine	12..4	23	1..9	7	5	148..13
Bonanza	Large, fine	7	29	1..4	3	5	84..42
James Vick	Medium, sound	16..7	20	3	13	3	198..54
Bermuda	Fair, sound	6..4	20	2	2..4	4	75..37
Belle (Wis.)	Medium, decayed	16	17	8..1	4..1	12	193..36
Watson's Seedling	Medium, sound	10..3	24	1..9	3	7	123..16
Luxury	Small, sound	3..2	29	11	2..2	1	38..10
Pride of America	Fair, sound	6	28	1	4..1	2	72..36
La Plume	Medium, sound	8..3	24	2..2	3..3	5	99..24
Mammoth Pearl	Fair, sound	11..2	27	2..7	3..2	7	134..58
Butter Ball	Medium, yellow flesh.	2	24	....	2	......	24..12
Early Sunrise	Medium, sound	20	17	3..1	2	18	242
Cap Sheaf (Ford)	Dacayed badly	23	16	3..9	2	21	278..18
Defiance (Wis.)	Large, fine	12..3	20	2..3	3..3	9	147..28
Burbank	Large, decayed	4..1	23	1..3	3..1	1	49..07

TABLE OF EXPERIMENTS---Continued.

Variety.	Quality of Seed.	Weight of 20 hills in lbs. and ozs.	Height in inches	Weight of five largest potatoes in lbs. and ozs.	Weight of large potatoes in lbs. and ozs.	Weight of small potatoes in lbs. and ozs.	Estimated yield per acre in bushels and lbs.
Early Mayflower	Medium, unsound	6..1	20	1..4	3	4..1	73..21
Irish Cups	Medium, sound	4..2	23	1	3..2	1	50..16
Wall's Orange	Fair, sound	9	24	1..6	4	5	108..54
Early Harvest	Fair, sound	17	14	2..3	3	14	205..42
White Elephant	Fair, sound	12..1	27	2	7	5	145..57
Pride of America	Fair, sound	10..4	25	2	7	3..4	124..01
St. Patrick	Fair, sound	10..5	22	1..8	8	2..5	124..47
Orange County White	Large, fine	4..2	25	13	1	3..2	50..16
Red Elephant	Medium, sound	12	26	2..2	8	4	145..12
Weld's Jumbo	Large, sound	4..4	28	15..3	1	3..4	51..25
Well's Seedling	Large, sound	20	20	3..4	17	3	242
Diamond	Medium, sound	24..1	20	4..5	20	4..1	291.09
Chicago Beauty	Medium, sound	16	19	3	13	3	193..36
Boston Cracker	Large, fine	23	18	3..12	20	3	278..18
Landreths Garfield	Large, fine	10..1	23	2..7	6	4..1	121..45
Adirondac	Large, fine	6..3	25	1..1	1..3	5	74..55
Corliss Matchless	Large, fine	20	19	2..7	18	2	242
Early Household	Medium, sound	12..2	22	2..1	6..2	6	147..04
Vick's Prize	Medium, sound	15..4	16	3..1	8..4	7	184..31
Jordan's Russet	Medium, sound	16	17	3..5	12	4	193..36
Collins Superb	Large, sound	9	26	1..12	3	6	108..54
Kennedy	Medium, sound	16	20	2..12	12	4	193..36
New Champion	Large, sound	8	25	1..4	3	5	96..48
Bliss Triumph	Large, sound	21	19	4	19	2	254..06
Stuben's Beauty	Medium, sound	17	18	3..12	14	3	205..45
Weld's No. 14	Large, sound	16..2	21	3..6	12	4	195..28
Great American	Large, sound	10	24	2..1	4	6	121
Pride of the West	Very fine, sound	8..2	25	1..2	5	3	98..40
Rosy Morn	Very fine, sound	24..7	18	4..1	19	5..7	295..42
White Whipple	Medium, sound	12..4	23	1..9	8	1..4	148..13
Ontario	Large, fine	6..1	28	12	4	2..1	73..21
Perfect Gem	Extra fine	12..4	16	1	9	3..4	148..13
Champion of America	Medium, rough, sound	8..2	27	1..2	5	3..2	98..40
Early Kent	Medium, rough, sound	16..4	16	2..9	14	2..4	195..37
Boston Market	Medium, unsound	18..2	19	3	15	3..2	219..40
Seedling	Medium, sound	16	22	4	13	3	193..36
Compton Surprise	Large, sound	17	19	3..9	14	3	205..42
Breeze's No. 6	Extra sound	8..4	21	1..2	5	3..4	99..40
Early Rose	Extra sound	22	16	4	18	4	266..12
Early Ohio	Extra sound	32..4	17	4..3	30	2..4	390..13
Western Star (Ohio)	Small, sound	8..3	24	1..4	6	2..3	99..04
Western Star (Wis.)	Medium, sound	4	27	1..4	2	2	48..24

METHODS OF CULTURE.

Table No. 2 exhibits the work in this direction in detail.

The potatoes in this experiment were planted on ground not particularly rich; it had never previously, however, been in crop. The sets were placed one foot apart in the rows, and the latter three feet apart. The area mulched covered a space 100x128 feet. After planting, the soil between the rows was furrowed slightly, to permit the passage of water.

The total yield under mulch was greater for the large seed pieces than for the small ones—as was the case the previous season; single eyes and two separate eyes yielding less in proportion to other methods of cutting than they did last year. This was due, in some measure, to the unfavorable character of the season, although the tops, in no instance, under mulch, were utterly destroyed, as was the case with many kinds in ordinary culture this year. The yield under mulch is ordinarily much greater than that of the naked ground, for the reason that the mulch furnishes the proper conditions (or nearly so) of temperature and moisture at the root, as well as coming near assuring the necessary mechanical condition of the soil so indispensable to the uniform and greatest possible development of tuber. This latter condition, however, cannot be realized unless the mulch is of sufficient thickness to maintain uniformity of temperature and moisture at the root; hence planting on the surface of the ground if the mulch is not a foot in thickness (if straw is used) is well-nigh useless. What would be a sufficient mulch in a moist climate would avail nothing under the cloudless sky and hot drying winds of the plains.

Mulch culture can never be practicable on a large scale in Colorado. It may be practiced in small gardens in localities, soils and seasons unfavorable to the potato under ordinary culture. The greatest care should be exercised in choosing a mulch, if of oat straw the crop will often be astonishingly large, and involve much labor to get rid of.

The kinds used in this experiment were Breeze's No. 6 and Peerless; varieties that have hitherto done well, but this season were well-nigh a failure in the unmulched ground.

Table No. 3 gives results in detail of an experiment with the potato cut in various ways and planted at various depths.

The sets were cut as nearly alike in size as possible without weighing them; the land was in excellent condition, but still by no means potato land; the planting was in rows three feet apart and the sets one foot apart in the rows, as accurate as tape and line could make them. Single eyes of good substance, and two separate eyes yielded in proportion about as they did last year, the largest and most uniform tubers though less in quality characterizing this method of cutting, while large seed and large seed pieces yielded the greatest weight and number of tubers to the acre. Three to six inches would seem, from the experience of two seasons, to be as deep as it is profitable to plant. Cutting to single eyes will always give the strongest stem, because but one, or at most but two stems, will grow, and the largest development of tuber is the expected and invariable result, with the minimum of small ones.

Small cut seed is, however, the exception, not the rule, at least in Colorado, owing to the danger of not obtaining a perfect stand, and there is

TABLE NO. 2.

Variety.	How Treated.	Depth buried, inches	Yield of 20 hills, lbs and ozs	Weight of small potatoes, lbs and ozs	Weight of large potatoes, lbs and ozs	Weight of five largest potatoes, lbs and ozs	Estimated yield per acre, in bushels and lbs.
Breeze's No. 6	One eye	2	28	8..2	20..1	3..10	266..12
Peerless	One eye	2	24	9..1	15	3..02	242..20
Breeze's No. 6	Two separate eyes	2	23	9..2	14	3	278..18
Peerless	Two separate eyes	2	22	6..1	16..2	3..04	266..12
Breeze's No. 6	One eye on surface	0	13..4	3..4	10..1	2..01	160..19
Peerless	One eye on surface	0	10..2	2..2	8..2	2	122..52
Breeze's No. 6	Seed end	3	26..1	4..1	22	3..03	315..21
Peerless	Seed end	3	28..2	5	23..2	3	340..40
Breeze's No. 6	Stem end	3	22..7	2	20..7	2..12	271..30
Peerless	Stem end	3	21..3	3	18..3	2..07	256..22
Breeze's No. 6	Large whole potato	3	30	12	18	3..06	363
Peerless	Large whole potato	3	31..4	9	22..4	3..12	378..07
Breeze's No. 6	Half potato	3	27..1	7..1	20..1	3..03	326..27
Peerless	Half potato	3	20..2	6	14..2	3..04	243..52
Breeze's No. 6	Small potato	3	32..5	10	22..5	3..08	390..59
Peerless	Small potato	3	30..1	12	18..1	3..09	363..45

much in this, if one's land is not in the best mechanical condition as there is danger of dry winds affecting the seed unfavorably. Small cut seed has the great advantage, however, of requiring a much less quantity of tubers to plant an acre, and if it can be shown that the use of small cut seed is as effective in producing a full crop as the use of larger pieces a great gain in the aggregate must necessarily ensue.

Amid the conflict of experiments and opinions it is a good plan to select only sound seed and if it is cut to single eyes to leave sufficient bulk to insure sustenance to the growing plant, and this will be impossible if none but the smallest tubers are used for seed.

TABLE 3—POTATOES PLANTED AT DIFFERENT DEPTHS.

Mode of Preparing Tubers.	Depth planted, in inches	Yield of 20 hills in lbs. and ozs.	Weight of table potatoes in lbs. and ozs.	Weight of small potatoes in lbs. and ozs.	Weight of six largest potatoes in lbs. and ozs.	Estimated yield per acre in bushels and lbs.
Small potatoes	3	28.3	17.3	11.3	4	341.04
Large potatoes	5	24.2	12	12.2	3.7	292.16
Seed end	5	21	16	5	2.9	254.06
Stem end	9	18.5	14	4.5	2.5	221.35
Two separate eyes	7	12.4	9.4	3	2	148.13
One eye	3	21.4	17.4	4	2.7	257 07
One eye	5	23.9	21.9	2	3	285.06
One eye	7	13.3	11	2.3	2.2	159.34
One eye	9	....	....	....	....	......

Large seed pieces, and particularly the seed end of the potato, start much more quickly and strongly than does the single eye. The seed end starting into growth first illustrates the fact that the potato is a branch, for the upper terminal and lateral buds on a branch above ground always grow first.

EXPERIMENTS WITH FERTILIZERS ON POTATOES.

The potatoes used in this experiment were cut to two-eye pieces the largest portion of the fertilizers was placed under the tuber, and the remainder on top, covered with soil. Care was taken, however, not to bring the seed in contact with the fertilizer, except in the case of the coal ashes, the latter being used merely for its mechanical effect on the land, which is often more effective than the employment of a fertilizer. The variety grown was the White Star, which blighted badly, hence we regard the experiment as a failure except in the case of the row treated with hen manure. The variety used in this case was early Ohio, not having a sufficiency of White Star. The following table shows results :

TABLE NO. 4.

Description of manures and quantities used per acre.	Yield of 20 hills, lbs and ozs.	Per cent. large potatoes	Per cent. small potatoes	Estimated yield per acre in bushels and pounds
350 lbs Tank manure	10	66	34	121
200 lbs Salt	8.6	37	63	101.20
200 lbs Gypsum	6.5	30	70	76.23
15 tons Coal asher	9	36	64	108.54
250 lbs Hen manure	30	75	25	363
50 bushels Lime	4.8	30	70	54.27
100 lbs Tobacco	4.3	25	75	50.40
No manure	6.2	40	60	74.28

IRRIGATION IN HORTICULTURE.

The science and practice of irrigation have been appreciated in all ages of the world's history by people possessing the most varied climates, and of every grade of civilization; the remains of whose work in oriental countries proves them to have had no small knowledge of hydraulic science and engineering devices. The profitable application of water to land may be said to be almost a science, requiring sound judgment, with experience and keen observation to insure success, and which practice alone can give, combined with a reasonable knowledge of the needs and nature of the plant's grown, as well as at least a physical knowledge of the soils with which we have to deal. For in many soils the presence of a hard-pan, whether it occurs there naturally or is induced by the slide of the plow and tramp of the horses by continued plowing at the same depth, must ever be a serious drawback to successful plant growth wherever it occurs. There are different kinds of hard-pan, and whenever the roots of plants strike and cannot penetrate them, they deflect and proceed in a horizontal direction, and hence suffer because not below the frost line, and within reach of permanent moisture. If such a deep rooting subject as alfalfa plant should fail on the unirrigated plains, it seems to me it will largely be due to the presence of a hard-pan preventing the roots reaching a permanent moisture.

Much conflict of opinion and experiences seems to exist among horticulturists in regard to the amount and frequency of irrigation needed in the culture of the larger fruits; such differences are due no doubt to a lack on the part of some, or of perhaps all, in not taking into consideration all of the attending circumstances, such as the character of the soil and sub.soil, the amount of moisture in the latter, which will hinge upon its contiguity to irrigating ditches or springs, to some extent on its elevation and the amount of irrigated land in its neighborhood. To justly recognize cause and effect, enables us to correctly interpret the teachings of nature, and this requires a most careful consideration of all the attending circumstances in relation to each other.

In open, sandy soils the water rises rapidly from below, but only to a moderate height, and are improved for horticultural purposes by having a more dense sub-soil that will draw up water from greater depths than if the whole depth of soil were of the same open, sandy character; while soils composed of very finely comminuted particles, the rise of moisture from below is comparatively slow, taking quite a long time in reaching its highest point, which is several times higher than those of more open character; these soils are compact, and when poorly tilled exhibit gaping cracks after irrigation, if not thoroughly cultivated. A well tilled soil maintains both a quicker supply of moisture from below and a slower surface evaporation, thereby insuring a more steady supply of moisture throughout the growing season.

Water exerts a beneficial influence upon the soil and upon vegetation, in that it supplies moisture, by which vegetation is made possible, and that by conveying and mingling such an amount of oxygen with the soil as could not get there as air, and which is requisite to form the nitrates and carbonic acid, and thus aid in dissolving the food elements of the soil for the growth of plants.

While water and the air it contains are all potent in the growth of plants, and by its aid we are enabled to obtain a liberal plant growth on the poorest soils; yet for the purposes of intensified horticulture seen in the growth of leaf plants it has its limits; fertilizers on upland soils especially are now indispensable to the horticulturist in dealing with the plants of our time, whose improved character can only be maintained in their greatest perfection by inexorably high culture.

The quantity and frequency of irrigation for the production of a full crop of any horticultural product, will depend upon a variety of considerations, and chief among them is the affinity of the plant itself for water, combined with a knowledge of the area and depth of soil upon which it feeds. The cultivator must observe whether the plants he wishes to grow are shallow or deep rooted, whether the roots break up into a mass of fibers near the surface or partake of the nature of a thickened underground stem extending several feet in length, with but few fibers, as the alfalfa.

The roots of the strawberry have been traced to a depth of three feet, extending nearly vertically, under the plant; the horizontal or fibrous roots cover an area scarcely exceeding that of the leaves, and from this we infer that close and deep cultivation cannot injuriously affect the roots.

The roots of the grape have been found at a depth of eleven feet. They will, during the season of greatest activity, go down to the sources of permanent moisture.

The rooting habit of the tomato and some other plants is the opposite of this. It possesses a multiplicity of fibrous roots which cover and feed upon an area quite five feet in diameter, and within twelve inches of the surface; its tap-root, however, we have traced to a depth of nearly three feet.

Vegetation should be encouraged to root downward for its permanent moisture. The chemical elements of fertility may exist in the soil in sufficient quantity; yet heat, light and air are the prime essential stimulating forces of plant growth, to which moisture is a contributing factor, and which we in this climate are privileged to apply or withold at will; to apply is the work of irrigation, to conserve is the province of cultivation.

The agriculturist is, however, more the slave of circumstances than is the gardener, for the latter can, by modification of treatment, keep his plants in a growing condition, and thus prevent their flowering at an improper time; indeed, a prime object of culture is to stimulate the vegetative function and thus keep in check the fruiting organs and delay the period of bloom.

Surface irrigation, whether practiced out of doors or in the plant-house, cannot be too strongly condemned, as it unquestionably induces surface rooting, and this is not a desirable result in any climate. That plants of a permanent character may be able to withstand the vicissitudes of our climate, their feeding roots should be well below the surface, and this result can be accomplished only by thorough and deep loosening of the soil, so that when irrigation is had recourse to it may be thorough; occasional sprinklings not being nearly so beneficial as an occasional saturation. Surface waterings, besides promoting surface rooting, induces a continuous evaporation and refrigeration of the soil, the latter acting as a wick, drawing water by capillary attraction to be absorbed at the surface by the air which it comes in contact with, and depositing at the surface its salts, which if in too great quantity, are destructive of all useful vegetation. The cooling of the soil by the application of too much water is strictly to be guarded against, especially in the grape, which requires warmth at the root as an element of success.

No more definite rule can be laid down in regard to the application of water to the roots of plants in the open ground than is found possible in its application to plants in flower pots in a plant-house. Plants, however, always resent too much of it at the root by their leaves turning yellow, and hence denoting defective root action, and which is often seen in plants in flowerpots, and perhaps less frequently in the open ground if cultivation has been thorough,

Land that is nearly level, and is of an open, porous texture, will, it is evident, take water readily, and irrigation in this case will mean something if followed promptly by good cultivation. On the other hand, land that rolls very much and is of an adhesive character, is exceedingly difficult to irrigate properly, and for hoed crops or young trees is certainly undesirable. For this reason we know that no rule as to the duty of water will apply, unless the soil is reasonably level and will readily take such water as we may wish to apply to it. Each cultivator must determine for himself as to the frequency and quantity of water necessary to constitute an irrigation of such plants as he may cultivate; remembering always that the feeding roots of young trees just planted are close to the stem for the first year or two; in after years, as the trees develop, they will generally feed upon an area as wide as the trees are high. Trees of upright growth, like the white ash and the Whitney crab, and trees of low spreading habit, like the box elder and the Tallman Sweeting apple, have each a rooting habit corresponding to their mode of growth above ground.

The remedy for the betterment of soils surcharged with the neutral alkaline salts, and whose texture is very compact and adhesive, is thorough tillage, and the leaching out of the alkali by copious irrigations combined with either natural or artificial underdrainage. The frequent irrigation of the soil assuring the inter-mixture of the surface deposit of alkali with the lower strata of the soil and thus diluting it and partially neutralizing its injurious presence. Cultivation, too, checks evaporation, and hence currently lessens the deposit of alkali on the surface. A loose, dry top soil acts as a cushion of earth, and air, intercepting the continuity of the upward passage of moisture, along the lowest plane of cultivation.

Among some sowed crops on adhesive soils there may be noticed now and then plants, or patches of plants, very much stunted and debilitated, which is due, to a very considerable extent, to the severe constitution of the stems at the ground surface, by the hardening crust that forms there after irrigation, and which cannot be broken up without injury to the growing crop. This pressure about the stems is a species of pruning, and is equivalent to the application of a ligature to the stem of a plant above ground, and which results in both cases in abridgement of the functions of vegetation. This hard crust also dries much more rapidly than would the same soil in good tilth ; it also absorbs water more quickly and powerfully than does the loose soil just beneath it, which hence parts more readily with its contained moisture, and which by reason of atmospheric influences, is quickly evaporated, hardening the surface and increasing the deposit of alkali there, and which is esaecially injurious to all surface rooting plants, which are chiefly annuals.

In British India, the government, after spending enormous sums to get water on the land, have been for some time confronted with the problem as to how to economically dispose of the surplus, and thus relieve the soil of the accumulated alkali that has in some cases rendered it unfit for cultivation.

For the intense cultures of the horticulturist, irrigation by means of a system of under ground ptpes would seem to commend itself. It is much practiced in California, and is known as the "Asbestine" system of sub-irrigation. Its merits are that it is economical of water, it holds in check the rise of the alkali, because the surface soil never leaks, (no water coming to the surface) and it has a powerful influence in inducing tne roots of plants to go down deep beyond the vicissitudes of climate.

At this elevation surface evaporation is rapid, water is quickly dissipated, and partly for this reason we believe that sub-irrigation offers positive advantages to the horticulturist, especially in the cultivation of land whose inclination forbids profitable surface watering.

In Italy the flavor of fruits is said to be inferior when grown by means of irrigation, and the seeds of vegetables are said to deteriorate to such an extent as to render a recourse to foreign sources a necessity, and that this may be true in this state we have some reason to believe, from a recent report of the chemist of the department of agriculture in regard to the wheats of Colorado, which shows them to have lost in weight, in nitrogen, in ash and albuminoids, as compared with former analysis. The deterioration of the seed in these important elements may, as Professor Blount suggests, be due to untoward seasons, but it it may also be due to soil deterioration, for as a rule we have as yet but skimmed the surface of our soils, leaving untouched a wealth of plant food, to be made available by deep and thorough tillage.

To assure the complete development of the plants we grow we must have in the soil the elements necessary to that end, for certainly the waters of irrigation do not contain them. Light, heat, a dry soil, with a moderate growth, are all essential to superior flavor in table fruits, and this desirable end it is in our power to attain, by surrounding our plants with conditions favorable to flavor, and the maturation of the seed.

Crops that succeed on alkaline soils are of root crops, beets, carrots, parsnips, turnips, and cabbage.

The cultivation of table fruits is not materially interfered with by the presence of a moderate amount of alkali, providing always that the water table has been lowered by proper under drainage.

It is a noteworthy fact that apple trees on the most alkalied land on the college farm are those that carried the most fruit for the past two seasons. This circumstance was also noticed by Mr. McClelland on his own fruit farm. I do not from this wish it to be inferred that I recommend such soils as being best for the culture of table fruits, but merely record the fact above noted, that the presence of the neutral alkaline salts are not inimiral to the successful culture of the larger table fruits.

With the positive assurance of sunshine and water, the horticulturist of this state is placed at an immense advantage over his eastern co-laborer, and can flatter himself upon a certainty of success, providing that in his management of such plants as make a definite annual growth (as the apple) he observes the cardinal principle that such growth should be moderate in amount, and thoroughly ripened; the dry air for which our country is proverbial inducing (if we withold water at the root at the proper time) an inspissated condition of the sap, which enables plants to withstand successfully the rigors of climate, and which induces in all cases the formation of blossom and of fruit.

REPORT ON GRASSES.

The grasses are without doubt the most important order of the vegetable kingdom, and probably the most natural one, that botanists have contrived. A technical knowledge of them is, however, difficult of acquirement, because of the similarity of structure of both genera and species; the differences being sought for in the smaller details, and which are made visible to us only by means of the microscope.

Their habits are familiar to most of as, as are the various and important uses of the seeds of wheat, oats, rice rye, barley and maize. The various genera and species are remarkable, too, in not exhibiting in any one case poisonous properties, but on the contrary are, in almost all cases, wholesome and nutritious, especially the seeds, in varying proportions, and in the stem, too, we find a no less remarkable uniformity of nature. All the grasses contain, in a greater or less degree, according to the species, a sugary mucilage; the creeping roots, too, are generally mucilaginous and demulcent; but they are especially valuable in holding the banks of streams and irrigating ditches, and for binding the shifting sands of the sea coast.

The day is coming when much of these plains will be seeded to the more useful grasses, either for permanent pasturage or to be used as a change crop in some regular rotation, and such species as now hold possession will either become extinct or will be found only in public or private herbariums.

But few of the native grasses are able to endure the contact of civilization; moreover but a few of them produce a sufficient weight of stem and foliage to warrant their retention in any system of soil culture, and many of them are (especially the native blue grass, agropyrum glacum) impatient of continued irrigation. There are, however, a few species that would seem worthy of trial, as Andropogon furcatus, known as blue stem on the plains, Panicum virgatum, and amarum, especially the former, and Chrysopogon untans, commonly called sorghum grass, Muhlenbergia Glomerata and comata are worthy of trial; these grasses are not impatient of irrigation, as is very well known.

No doubt there are other indigenuous grasses possessing merit, and that are at least worthy of trial, and with this object in view we have collected seeds of those most promising for trial under cultivation.

Of cultivated grasses the only species sown to any extent in this state is timothy. It yields an extraordinary growth with irrigation, especially far up in the Rocky mountains, where the average temperature is lower than that of the plains. Native timothy is hardly less luxuriant, but as to how it would behave under repeated irrigations remains yet to be determined.

Red-top has been sown to a small extent in wet meadows, with the best results. It is a native, too, growing luxuriantly in moist meadows and along the streams in the mountain parks. The panicle of the native Red top is much thinner than that of the cultivated type, and of a somewhat graceful and drooping habit.

June grass, Poa pratensis, is also native to the Rocky mountains. It is found only at high altitudes and in much dryer places than Red-top, its habit of deep rooting enabling it to withstand extremes of drought better than some other species.

The White Bent, Agrostis alba, is nearly as plentiful as Red-top, but with less luxuriance of stem and leaf; the panicle ranging in color from light green to purplish brown.

The above grasses being native here, are perfectly at home, and seem in a greater measure to meet the wants of stockmen than do any other grasses that have as yet been tried.

Other cultivated gaasses that are especially worthy of trial on a larger scale than comes within our province, are the Meadow Foxtail, one of the earliest to commence growth as well as to flower. Like other Foxtail grasses, it prefers moist situations, and is valuable for early pasture. Its seeds are light, averaging about five pounds to the bushel.

Tall Oat grass is among the earliest of all the cultivated grasses to grow in the spring; it roots very deeply, starts growth quickly after being cut and is adapted to thin soils and dry situations. It seems to succeed admirably in Kansas and the southwest, and certainly made an excellent showing the past season at this place.

Taller Fescue, *Festuca elatior*, also gives evidence of value as a pasture or meadow grass. Nearly all the Fescue grasses grow in tussocks, are nutritious and are much relished by stock.

Meadow Fescue resemble the above. It is of vigorous growth, yielding an abundance of nutritious stems and leaves.

English Rye grass proved to be early and productive. Its growth is dense, and is apparently hardy.

Italian Rye grass growing alongside the above winter-killed badly.

Orchard grass ought to be one of the best for the northwest, especially in its ability to resist drought. It had but one irrigation this season, yet withal its appearance attests its merit.

For light, thin soils, on dry hill sides, the bunch grasses,as red Fescue, and the forms of *Festuca ovina* should succeed, especially when helped out by irrigation.

My notes on the cultivated grasses are tabulated in table 5, which shows their height in inches at certain dates during the growing season, how they wintered, when they bloomed, with some remarks on their general appearance, and value. None of the grass plats were irrigated until after they were cut; each plat had had, however a liberal top dressing of sheep manure which helped their growth amazingly.

In regard to the best lawn grasses for Colorado, we will say that where ground has much of a slope it is best to sow white clover or red top, in sufficient quantity to cover the ground quickly with a thick sward, and if the soil is fairly fertile, its mechanical condition good and the seed is sown early, a good growth may be expected before irrigation becomes necessary. A little blue grass might be sown at the same ime. It will ultimately take possession, no matter what grass has been sown. It makes the very best of lawns; it is, however, much more difficult to cut with a lawn mower than either clover or Red-top.

TABLE NO. 5---GRASSES.

Name.	Height in inches on April 12th...	Height in inches on May 8th.....	Height in inches on May 24th....	Height in inches on June 12th....	Remarks.
Tall meadow Oat grass........................	6	12	19	36	Flowered June 22nd.
Orchard..	2	9	11	20	Flowered June 20th.
Tall Fescue......................................	4	9	11	22	Flowered June 20th.
Meadow Fescue................	5	9	14	21	Flowered June 23rd.
Hard Fescue......................................	1	3	5	5	Flowered July 1st.
Creeping Bent....................................	2	4	5	9	In flower July 2nd, good lawn grass.
Meadow Soft......................................	4	9	13	16	In flower June 30th.
Meadow Foxtail...................................	5	9	11	17	In flower June 1st.
Kentucky Blue....................................	3	8	10	16	Bloomed July 1st, for lawns or pasture.
English Rye......................................	5	10	14	16	Bloomed June 22nd.
Yellow Oat................................	3	6	9	16	Bloomed July 6th.
White Clover.....................................	3	4	6	10	Bloomed May 30th.
Red Clover.......................................	5	10	15	17	Bloomed May 30th.
Alsike..	3	4	6	10	Bloomed May 30th.
Alfalfa...	4	12	22	28	Bloomed June 20th.
Saintfoin	2	7	12	23	Bloomed June 12th.
Red Top..	3	6	9	12	Bloomed July 3rd, excellent for lawns.
Timothy..	3	7	9	13	Bloomed July 9th, a meadow grass.
Hungarian..	...	...	1	2	Bloomed August 24th.
Sheep's Fescue...................................	2	3	4	4	In bloom May 24th.
Schraeder's......................................	...	5	7	10	Annual of little value.

REPORT ON WEEDS.

That considerable apathy is shown by farmers and townspeople alike in this state on the weed question cannot for a moment be doubted by anyone who has seen much of its agriculture or horticulture.

With the progress of agriculture the use of water has of course been a necessity, and this with our climate has rendered a proper appreciation of the subject, with a view to their extermination seem like arming oneself against a sea of troubles.

It is but a question of time for the worst weed pests of the older states to be introduced, and when here they are very likely to stay, for Colorado is a perfect paradise to them.

Fortunately, weeds are only particularly destructive on irrigated lands, the plains are too dry, the soil bakes too much for the running weeds to obtain much foothold; our weeds, too, are many of them annuals, and hence are more easily kept in subjection than those that are perennial, and which have underground stems. All plants are endowed with means more or less effective for their reproduction; such as possess, superior growth of root and top, seed early and freely, or perhaps possess some especial contrivance for their dissemination, take possession of the soil and smother out those less well endowed by nature.

The poverty weed, so well known to the farmers of this state, is a case in point; its vitality is such that we may compass the whole gamut of natural conditions and still it is at home, outrivalling in tenacity the infamous pussley, whose home is at least that of two continents, and which, while destructive enough for the time it has been in the state, finds a period to its luxuriance in the cool nights of early summer and fall.

Another well known plant in this state is the cat-tail (*Typha latipolia*), which spreads everywhere, for the reason that its seeds are light as air, and are carried by the wind long distances; when they alight on a spot sufficiently moist they germinate, the abundant moisture furnishing the proper nidus to insure its continuance.

The spread of fox-tail (*Hordeum jubatum*) on the plains and in the mountains is something appalling; it stretches in broad patches wherever the conditions are favorable, and it is rarely that they are otherwise. The presence of this grass, and many others that are worthless under all circumstances, urgently suggests the propriety of under draining, or open ditches, to lower the water line, and thereby induce the better grasses to obtain a foothold.

Some new species are continually being introduced, and many old ones are rapidly extending their domain and increasing their grip on the soil by reason of the many new farms opened up and the careless and profitless culture of old ones. Many have their seeds in the crops grown, and which are too often difficult to detect because of their resemblance to the grain sown; their size, too, renders separation difficult. Proper regard then should be had to the purity of the seed sown, nothing short of this will save future trouble and expense.

The practice of thin seeding so common in this state cannot be but a fruitful source of the almost innumerable host of weeds seen upon so many farms. Thin seeding is no doubt all right with good seed, and where the land is tolerably clean and in good heart; and especially is it all right in countries where a farmer may sue his neighbor for neglect to destroy the weeds on his farm. We believe in sowing heavy enough to keep at least a fair proportion of the weeds in subjection or, if land becomes too foul for profitable cultivation to put in clover, or some vigorous grass to smother them out. Next to this the best remedy is to ceaselessly cut them down, whether they are annual or perennial, and this cutting must be before seeding; it must also be thorough and radical or it will fall short of its purpose.

There is a point in most plants called the collar, which is analogous to a similar point in vertebrate animals at the base of the brain, and which if cut or injured at this point will insure their destruction. Many plants when cut down at the period of blooming have a sufficiency of nutriment in their leaves and stems to perfect a crop of seeds.

The vitality of the seeds of weeds is undoubtedly far in excess of those of cultivated plants because a weed is a natural product, and is constantly renewing its vigor from seed, the production of which is its sole object; so that the seeds of weeds have often been buried at depths far below the influences that induce germination, and when ultimately brought to the surface, a crop of weeds was the result.

The plant under cultivation is more or less removed from the natural, and hence surrounded by artificial conditions; it is in fact a product of the art of man, and hence necessarily conforms to his will in whatever direction it has been developed by him, so long as he protects it from the conditions of nature.

Weeds were not created however without purpose; they occupy an important place in medicine, they quickly clothe naked soils, and when turned under with the plow, or in their natural growth and decay, furnish a nidus for the mighty oak, and perhaps they have another use in that they force man to cultivate the soil if he would reap of its fruits.

REPORT ON FORESTRY.

The subject of forest tree planting does not as yet receive that attention at the hands of the people of this state which its importance demands. The people of the country at large, however, are waking up to the necessity at least of using judiciously our present supply of tree growth. Some of the most serious economic questions this country has ever been called upon to consider are grouped under the comprehensive head of forestry. The production of fuel and timber for the supply of the various industries of life is but one phase of the question. Another, and quite as important, is the connection between certain portions of the western forest area and a steady supply of water for the rivers by which irrigation is made possible, and still another is the possibility of danger from mountain torrents.

To mould and shape public opinion each individual who feels an interest in rural affairs, as well as agricultural organizations of every kind, have abundant opportunity for the performance of missionary work, in educating public opinion up to a better appreciation of the positive and beneficial results accruing from the presence of trees and shrubs on every farm whether large or small.

It is true that the necessities of pioneer farming warrant, to some extent, the lack of interest shown in tree planting in Colorado, just as wheat raising is tolerated by the same necessities, and, if we may be allowed the digression here, this kind of farming is always productive of impoverishment in every way, if long persisted in, because it impoverishes the soil, encourages the presence of weeds, deteriorates the seed sown and repudiates the science of agriculture. Too many of us know no future; we live but to day, for the day and by the day; we want quick returns. The strawberry is commendable because of this, but the apple is a slow jade. However, time and the logic of nature will remedy this.

Wherever civilization has obtained a foothold tree growth is a necessity, and contributes as much to its advancement as that of any other natural product. From the cradle to the grave, in all the industries and pursuits of life, we are incessantly indebted to trees. We do not believe that any one now living will see forests of trees on these plains, but we do believe that they will see groves of trees, plantings by the roadside, along the irrigating ditches, near the dwelling and the barns on every farm worthy of the name, as a protection against wind to man and beast, to orchards, and as a remedy for the dry winds that almost annihilate one's ardor for fruit growing. This state, with its varying elevations, is hardly equaled in the beauty and health-giving qualities of its climate, will always be in demand. Her soil is fertile, and capable, with irrigation, of producing as wide a range of agricultural products, when the conditions are properly understood, as the most favored of the states. In spots, it is true, the soil may be feeling the effect of some special and exhaustive culture, but still not beyond the reach of speedy recuperation. It is safe to say that by the planting of wind breaks along the irrigating ditches and wherever else such plantings might suggest themselves, that the average crop of products of Colorado farms would be measurably increased thereby.

Fires are one of the most difficult things to deal with in the preservation of our mountain tree growth, doing, it is estimated, a hundred times as much damage as the axe. Many people do not think of the value of a tree, and too frequently do not care where a fire may end, so long as it does not affect their own interest. Large numbers of saw mills are doing their deadly work among the mountain forests, and the owners are not likely to be much hindered in their work by sentimental growlers about the welfare of future generations. The lumberman's greatest sin is in the damage he does to such trees as are not of a commercial value, by leaving the ground strewn with such as are often wantonly cut down, and which gives the incipient fire the headway that ultimately destroys the forest. The thinning of trees in a forest by the removal of such as are of mature growth is beneficial to the remainder, because every species of tree at a certain age ceases to be profitable, and had better be removed that such as are younger may have a better chance.

Any land that will produce good farm crops will grow good trees, and we shall succeed in producing hardy trees only by practicing such culture as will induce an early formation of the terminal bud, and by employing such kinds as make a definite annual growth. The Ailanthus fails because its growth appears to be indefinite and hence its tops are killed by the first frosts of autumn.

The sowing of tree seeds where the plants are to remain is usually poor economy. An exception might be made, perhaps, in favor of the walnut and butternut, whose fruit is large and growth strong from the start.

We recommend generally the sowing of seeds in frames, seed beds or nursery rows when they can receive proper care and attention during their infancy. At the same time we think that the average farmer would not be likely to meet with much success in his efforts to raise his own trees. He can usually buy them so much cheaper from the nurserymen, who possess the necessary skill and appliances to insure success.

The soil should be such as will not bake; it should be in a good state of fertility and tilth, be free as possible of weeds and the seed fresh. The seed is best sown in rows about nine inches apart, that weeding and cultivation may be properly and seasonably attended to. The fruit of most nut trees are best sown in the fall, as are also the seeds of the ash, the horn bean, the pear, locust, plum, peach, apple and some of the maples, in order that they may get a good freezing, which insures their vegetating the following spring.

The white and scarlet maples, black birch and the elms ripen their seeds in early summer, and should be sown as soon as gathered.

Seeds sown in the fall should be covered with a mulch to keep the soil from heaving and to prevent their drying out. The use of lath screens are always helpful in this climate to shade from the hot sun. Two to three years old is about the age at which they are transplanted for forest purposes. If grown for ornamental purposes, the nurseryman transplants them every two or three years, and if handled in this way they may be transplanted in any climate when fifteen to twenty feet high.

Thə soft wooded kinds may also be propagated from cuttings. They make the poorest quality of timber. It is nature's axiom that whatever is rapid in growth is rapid in decay. The trees of softer texture, however, whose fiber is susceptible of being reduced to pulp and rolled into paper or converted into the manifold uses to which wood pulp is applied may prove as valuable to this and future generations as the oak has been to the past.

The ash, catalpa and tulip tree should be sown thickly to insure a crop, as much of the seed is imperfect.

The birches, alders, mulberry, catalpa and platanus are best sown in the spring.

Evergreens are the most valuable trees for shelter and ornament but are much more difficult to obtain from seed than any other class of trees. Nor can they be grown as profitably for timber, even in the most favored sections of the country. as deciduous kinds.

The beds in which the seeds are sown should be covered with lath screen and the position as sheltered as possible from the sun and drying winds. The first few months, until the formation of the terminal bud, is their most critical time. A close confined atmosphere with too much water will cause the young seedlings to disappear in twenty-four hours. We protect the young seedlings in winter with a mulch of leaves or pine needles retaining the screens overhead. We transplant after two years in the seed bed although strong growing pines, like the Austrian Scotch and Red, are often fit in one year. The Junipers, Yews and some pines will not as a rule vegetate until the second year.

The seeds of some kinds, as the Scotch Austrian and pitch pines, retain their vitality, if kept in a cool, dry place, for years, while the silver firs quickly lose their vitality if not speedily consigned to mother earth.

The best time to transplant evergreens is still a debatable question by people who prefer to discuss a theory to putting it into practice. Evergreens have their periods of growth and rest, as do other plants, and under certain favoring conditions may be removed when in full growth, but the dormant season is the one most likely to favor success under ordinary circumstances. We have been equally successful in October and May in removing the mountain evergreens, paying particular attention to the sacking of the roots and making sure that the latter do not dry.

The majority of evergreens may be propagated from ripe wood cuttings or from cuttings of the young growing wood, the latter being the more difficult operation. The cutting is best taken with a little of the two-year-old wood attached.

The cuttings are set out in cold frames in a shady place, well watered, and so remain until spring; no sun must get at them until they are rooted. for if the leaves are once excited into growth no root formation can occur afterwards The formation of roots occurs at a lower temperature than would be sufficient for the growth of leaves and success will hinge on our success in maintaining a cool atmosphere until the emission of roots has taken place. Evergreens may be propagated from cutting of the current season's growth while yet green if one has control of bottom heat such as that given by a hot bed we have been successful the past season in rooting a fair proportion of red and silver spruce in this way. The following shrubs are in every way admirable for Colorado:

COMMON NAME.	SCIENTIFIC NAME.
Sweet Shrub	Calycanthus floridus
Button Bush	Cephalanthus occidentalis
Sweet Pepper Bush	Clethra almfolia
Bladder Senna	Colutea arborescens
Golden Bell	Forsythia viridissima
White Althea	Hibiscus syriacus
Hydrangea.	Hydrangea paniculata grandiflora
Snowberry, red	Symphoriocarpus vulgaris
Snowball	Viburnum opulus
Spiraea	Spiraea billiardi, and other varieties
Lilac, purple and white	Syringa vulgaris
Privert	Ligustrum amurense
Honeysuckle	Lonicera grandiflora
Mock Orange	Philadelphus coronarius
Currant	Ribes floridum
Weigelia	Weigelia rosea

The annexed list of trees are growing on the college grounds. There are many others under trial but it will take another season to enable us to pass judgment on them:

TABLE NO. 6—DECIDUOUS TREES FOR COLORADO.

SCIENTIFIC NAME.	COMMON NAME.	REMARKS.
Quercus rubra	Red Oak	Hardy, a good grower, timber inferior.
Juglans Cinerea	Butternut	Vigorous grower, hardy and desirable.
Juglans nigra	Black Walnut	Vigorous grower, hardy and desirable.
Fraximus Americana	White Ash	Vigorous grower, hardy and desirable.
Fraximus viridis	Green Ash	Small tree desirable for moist places.
Castanea vesca	American Chestnut	A valuable tree, hardly and desirable.
Butula nigra	Black Birch	Desirable, hardy, wood excellent.
Acer dasycarpum	White Maple	Rapid grower, timber desirable.
Acer rubrum	Red Maple	Rapid grower, hardy, timber inferior.
Prunus serotina	Black Cherry	Medium grower, hardy, wood desirable.
Ulmus Americana	White Elm	In every way a desirable tree.
Ulmus campestris	English Elm	Ornamental and desirable.
Berberis vulgars	Common Barberry.	A good hedge plant.
Berberis canadensis	Am. Barberry	A good hedge plant.
Carpinus Americana	Hornbeam	Tree small, hardy, and we think, desirable.
Alnus glutinosa.	Common Alder	Growth rapid, tree hardy and desirable.
Morus alba	White Mulberry	Medium size, hardy and may prove desirable.
Rhamnus catharticus	Buckthorn	A valuable hedge plant.
Shepherdia argentea	Buffalo Berry	Tree small hardy and desirable.
Cornus Siberica	Dogwood	Tree small, hardy and desirable.
Betula lenta	Sweet Black Birch	Graceful habit, hardy and desirable.
Caragana Siberica	Siberian Pea Tree.	A small tree, hardy and desirable.
Acer negundo	Box Elder	An excellent shade tree.
Gleditscnia triacanthos	Honey Locust	An excellent hedge plant.
Elaegnus hortensis	Wild Olive	A small tres, desirable.
Pyrus aucuparia	Mountain Ash	Medium size, hardy and ornamental.
Pyrus pubens	Mountain Ash	Medium size, hardy and ornamental.
Populus Riga 39	Russian	
Populus lanrifolia	Russian	A common street tree of northern Europe.
Populus inverta	Russian	
Populus 115 versueli	Russian	
Populus Riga 31	Russian	
Populus Riga 122	Russian	
Populus certevensis	Russian	
Populus Riga 40	Russian	
Populus Riga 24	Russian	
Salix fragilis	Russian	Common to northern Europe.
Salix laurifolia	Russian	A beautiful, small sized tree.

REPORT ON FRUITS.

THE ORCHARD.

There are two small orchards on the college farm. One has a northern aspect with a good atmospheric drainage, the soil of which is a loose, gravelly loam which does not bake much after irrigating. The second is planted on more adhesive soil, nearly level, with wind breaks on the west and northwest of cottonwoods and honey locust. Many of the first plantings in both orchards have winter killed, notably so in the latter, and of the Tallman Sweet variety; the vacancies are now filled with varieties of greater merit.

The varieties of bearing size that are uninjured are the Duchess, Whitneys No. 20, Red Astrakhan, Brier Sweet, and Ben Davis and are fine symetrical specimens of their kinds. Both orchards contain 622 trees, of ninety-five varieties, all of which are in excellent condition to winter safely and ought tc carry considerable fruit next season.

They were irrigated three times, and mulched the first season. The general treatment, and planting of many varietias, baving for its purpose the determining as to what methods of culture and selection of kinds, will give us trees that are hardy, vigorous and productive, taking into consideration all the circumstances under which they are grown.

The Russian varieties, procured of Prof. Budd, of the Iowa Agricultural college, have done finely; when planted they were somewhat crooked and misshapen, but the past season they have made an excellent growth, and are certainly as clean and symetrical trees as could be desired.

But very little has been done in the west in raising apple seedlings from fruit matured here. Seeds of seven varieties were sown last spring, a few came up this summer, and no doubt many more will come up next spring. a record will be kept of the percentage and parentage of all seedlings. No doubt many valuable varieties may be produced in this way, the products of kinds bred for successive generations in one line and inured to the conditions under which they are originated.

The history of all fruit culture shows that the more good fruit people have the more they want, and fruit of good quality, invariably brings good prices.

All the northwestern states have had, and are still having, many difficulties to overcome in the culture of the larger fruits, and our own state has hers, but, once the conditions which are the price of fruit culture in this state are understood and put in practice, orchards will then, we believe, be abundant and incorporated into the husbandry of the state. Our own methods of culture, or lack of it, has nearly as much to do with our success, or failure, as the climate. Much of the tree stock that is lost in the hands of the farming community must, we think, be attributed to careless planting, and lack of care for the first two or three year. Nothing seems more difficult for some people to appreciate than that trees, and plants generally, need rather more care, and attention to the smaller details, than is necessary in the practice of the rougher arts of the field.

The modern apple tree is more or less an artificial product, surrounded as it is in this state by conditions to which it is unacustomed, it is not to be wondered at that it should succumb if even its primary needs are ignored.

The obstacles to the culture of the apple in this state are, alternations of temperature, over-heating of the soil, high winds and the injudicious use of water. We cannot control the temperature of the air, but we can produce trees that will be proof against it. The over-heating of the soil we may get over by the use of mulch when the trees are young, and when in the bearing state we may seed to buckwheat or to clover, leaving the prunings on the ground as a mulch. The high winds we may mitigate by the use of wind breaks of the crab apple; and the application of water is entirely in our own hands to use as judgment may direct. A mulch, however, has no influence in restraining the buds from bursting into leaf; our mulch merely affects the roots, keeping them cool and moist, the tops are often in the atmosphere of early summer, and hence will commence growth in consequence; drawing food supplies from that already stored up for future use in the buds and stems.

In regard to varieties, we are most likely to succeed only with the most hardy sorts of Siberian crabs and their crosses, Russian apples, and perhaps some few other sorts, that come near these in their leading characteristics. Varieties that do not start growth too early in spring, and whose wood has been thoroughly matured will often pass the winter unharmed, even though they are not thoroughly hardy. We prefer trees grown in this climate or one as nearly similar as possible, but if obliged to take them from one radically different would endeavor to obtain such as were grown under conditions favorable to perfect foliage and ripening of the wood. Low-headed trees are the safest for the plains, they are self-protecting, and in a measure prevent the trunk from becoming overheated in early spring and inducing an early rise of the sap.

Whether they should be planted much deeper than in the nursery will depend on the character of the soil and sub-soil.

In regard to pruning, we deem it unsafe to prune much as vitality is often impaired by it. Cottonwoods that have been pollarded in this state very frequently decay where they have been cut over. Pruning the tops to let in light and air is common enough and beneficial in moist equable climate but the character of our climates renders that unnecessary.

Plant none but healthy, vigorous trees, two or three years old, and by mulching them the first season and otherwise attending to their needs, enough fruit may be raised by every farmer for his own use, and that is a considerable item.

Trees and plants generally start into vigorous growth in proportion as they are healthy and vigorous, and that the proper conditions of moisture and plant food are available when the plant needs them. Trees planted in tilled land, and the weeds allowed to grow and take possession, are placed at a great disadvantage; they cannot make a vigorous growth, for reasons that must be apparent, and chief of these in this climate is that the moisture and plant food, that should be the portion of the plant cultivated, is pumped from the soil by the weeds and grasses which are always greater scavengers than young trees with but few feeding roots.

SMALL FRUITS.

Strawberrries.—The varieties in the appended list were planted in the spring of 1884, in rows three feet apart, and received the usual attention during the growing season. In the fall they were mulched, which was allowed to remain until the fruiting season was over.

In the table we have grouped our notes gathered during the year, comprising the date of flowering of each kind, the date on which the first ripe fruit appeared, the number of fruit stalks to each plant and the average number of berries per stalk, with some notes as to how each variety behaved during the season. Many of the kinds need further trial, when possibly age and the superior quality of the soil would improve their standing. Our statistics say that the following kinds were the most profitable: James Vick, Manchester, Hart's Minnesota, Crescent Seedling, Indiana, Black Defiance, Jucunda and Bidwell. The habit common to some varieties of setting a great many more berries than they can mature is not so much of an objection in Colorado as it is in places where irrigation is not practiced, for if the soil is rich enough and the plants possess the vigor to respond to the stimulus afforded them, they will certainly not fall far short of maturing such fruit as they may set. The best flavored berries were Jenning's White, Golden Queen, Chas. Downing, Gypsy, Kentucky, Manchester and Mt. Vernon. The latest kinds were Memphis, Late Kentucky, Cornelia, Vineland Seedling and Emma. The earliest were Crescent Seedling, Crystal City, Phelp's Seedling, Nigh's Superb, Piper's Seedling and Bidwell. The varieties that rusted badly were the Wilson and Sharpless; the weak growers Jennings' White, Golden Queen and some others were slightly affected.

TABLE NO. 7—STRAWBERRIES.

Variety.	Flowered on May—	First ripe fruit on June—	No of days between flowering and fruitage	No. fruit stalks per plant	Average No. berries per fruit stalk	Remarks.
Bidwell, P	10	10	31	2 to 3	6	Foliage good, productive and desirable.
Black Defiance, H	10	15	36	2 to 3	10	Foliage abundant, dark green near the ground.
Big Bob, H	12	15	32	1 to 2	10	Foliage large, not productive, fruit poor.
Cumberland Triumph, P	8	10	33	2 to 3	7	Weak grower, fruit soft, not desirable.
Cetewayo, P	10	20	41	1 to 2	4	Very late, needs further trial.
Cornelia, P	8	15	38	2 to 3	7	Foliage healthy, valuable for family use.
Chas. Downing, P	10	12	33	2 to 4	6	Foliage healthy, needs further trial.
Champion, P	10	10	31	1 to 2	6	An ironclad berry, very productive.
Crescent Seedling, P	6	5	30	2 to 3	5	The most profitable of all varieties.
Crystal City, H	12	12	30	2 to 3	9	Requires further trial.
Daniel Boone, P	12	20	39	1 to 2	4	Very late, fruit soft, a family berry.
Endicott's Seedling, H	10	12	33	2 to 3	3	Foliage good, flavor fine, productive.
Emma, H	16	27	42	1 to 2	4	Foliage poor, flavor good, fruit knotty.
Gipsy, P	10	10	31	1 to 2	4	Foliage strong, not productive.
Golden Queen, P	12	17	36	1 to 3	5	Good grower, flavor good, early and productive.
Great American, H	12	20	39	2 to 3	7	Foliage weak but healthy, productive.
Haddlestone Favorite, P	8	15	38	1 to 2	4	Vigorous and productive.
Hart's Minnesota, H	12	15	34	1 to 3	9	Very productive and desirable.
Indiana, H	12	18	37	1 to 3	9	Profitable berry of medium quality.
Jucunda, H	10	14	35	2 to 3	10	Foliage weak, productive, flavor good.
James Vick, P	10	12	33	2 to 4	12	Vigorous, fruit firm, productive.
Jersey Queen, P	12	15	34	1 to 3	4	Not productive.
Kentucky, H	10	20	41	1 to 2	8	Very late, foliage good, desirable.
Lenning's White, H	10	15	36	1 to 4	4	Weak grower, desirable for family use.
Marion	14	20	37	1 to 4	4	Poor foliage, not productive.
Manchester, P	8	12	35	1 to 3	11	Very productive and desirable.
Mt. Vernon, H	12	13	32	1 to 2	5	Flavor good but not productive.
Memphis Late, H	12	22	42	1 to 2	6	Very late, strong grower.
High Superb, P	8	10	33	1 to 2	7	Resembles the Crescent, not so productive.
Mrs. Garfield, H	10	14	35	1 to 3	5	Requires further trial.
Piper's Seedling, H	10	13	34	1 to 2	4	Strong grower but not productive.
Phelps, H	7	10	34	1 to 2	10	Vigorous grower, flavor inferior.
Prince of Berries, H	10	14	35	1 to 2	7	Foliage unhealthy, excellent flavor.
Kay's Prolific, H	10	10	31	3 to 4	6	Strong grower, flavor agreeable.
Russell's Advance	10	14	35	2 to 3	9	Vigorous grower, fruit soft and near the ground.
Senaca Queen, H	10	15	36	1 to 2	9	Vigorous grower, excellent flavor; for family use.
Sharpless, H	12	15	34	1 to 3	7	Foliage unhealthy, not desirable.
Vineland Seedling, H	12	21	40	1 to 2	8	Late, strong foliage, fruit borne high, needs trial.
Wilson, H	10	12	33	2 to 3	10	Foliage unhealthy but productive.
Warren, H	8	10	33	1 to 2	4	Weak grower, not desirable.
Atlantic, H	8	12	35	2 to 3	6	Not desirable.

REPORT ON GARDEN VEGETABLES.

TURNIPS.

Nineteen varieties, or so called varieties, of the turnip, were sown in drills three feet apart, the tops ultimately covering the space between the rows. Two seeds were allowed to one inch of row, and were thinned afterwards to six inches apart for the large varieties and to four for the smaller kinds. The ground was in the best possible condition as regards fertility and mechanical condition.

The turnip is divided into three classes :

One is represented by the strap-leaf varieties, which are very rapid growers, and are sown either very early in the season or very late. They are generally delicate in flavor, but deficient in nutriment.

The second, of which the Aberdeen and Yellowstone are typical, grow larger and keep better than the first. They are sown in this locality the last week in June.

The third class is the rutabaga or Swede turnip. These are winter varieties. They need the whole season for their complete development, and are the most nutritious of turnips.

Seedsmen have a long list of varieties, but experienced growers use but a few kinds.

The following are the best of those tried: Of early kinds, Munich, Purple Top Strap Leaf and Early Flat Dutch are the most desirable. The White Strap Leaf is but a form of the latter.

Of intermediate kinds the Aberdeen, Yellowstone and Montmagny are the best.

The White Norfolk, Cow Horn and Red Tankard are excellent for stock purposes, but when young are good for table use also.

Among rutabagas the American Improved is the best. The flesh is of good quality, solid and tender. Laing's Improved is difficult to distinguish from the above.

White Swede is a productive variety, but becomes "corkey" quicker than the American Improved.

The turnip and the cabbage have been amazingly improved of late years. The wide diversities of form and adaptibility acquired, with new endowments, has greatly extended their value, in better fitting them for a greater variety of soils and circumstances. Thus we have varieties that grow from the surface of the soil and others that bury themselves to their crowns. Some again grow quickly, while others need, in Colorado, nearly the whole season to reach their full size, and all the varieties keep in proportion to the rapidity of their growth. The turnip will grow on almost any kind of soil, provided it is mellow. The soil, however, must not be too rich, or the tops will be large without a corresponding development of root. The black flea troubles these varieties some, but if taken in time is readily driven off. The Aphis has an affinity for the Brassica family. It was destructive this year to all varieties with light green foliage. We have found liberal applications of salt beneficial in giving the plants increased vigor.

The data noted during the season are arranged in the accompanying table :

TABLE NO. 8---TURNIPS.

Variety.	No. days vegetating	Yield per row of 20 feet in lbs and ozs	Height of top in inches	Weight of six largest in lbs. and ozs	Estimated yield per acre in bushels and lbs.
Improved American Purpletop	7	30	16	12	392..40
Laing's Improved	7	36	20	13..1	471..16
Large White Norfolk	7	44	18	18	576
Cow Horn	6	20	16	6	261..45
Montmagny	7	47	18	20..3	615..15
Purpletop Munica	7	32..6	17	13..1	425..25
White Egg	7	30..2	14	12	394..50
Jersey White	6	30..4	14	11..4	393..5
Red Tankard	7	32..3	16	12..1	422..10
Bangholm Rutabaga	6	26..7	18	13..3	348
Hartley's Swede	7	31..4	18	14..4	410..10
Yellow Aberdeen	6	48	20	21	628..20
Redtop Strap Leaf	7	26..2	16	12	342..30
Improved Tetlow	7	44..6	18	24..7	582..30
White Russian	7	40	20	19	523..35
Early White Strap Leaf	6	18..2	12	6..2	237..45
Early White Flat Dutch	6	17	12	7..1	222..30
White Garden Stone	5	19..4	13	7	253..50
White Six Weeks	6	16..3	12	6..2	212..4

BEETS.

Table No. 9 shows results with the beet; twelve varieties were grown on well enriched, deeply subsoiled ground.

The seed pieces were sown two inches deep, allowing one piece to one inch of row; the rows were three feet apart.

The beet is more at home on alkali soils than any other plant we grow; it attains mammoth proportions with irrigation—and by having the rows far enough apart to insure thorough working of the soil it quickly attains its growth.

The really distinct varieties of this plant are but few. Bassano is the earliest, but its flesh is light-colored and hence not attractive; its flesh is, however, tender and well-flavored. Egyptian Blood Turnip is a later variety but of excellent color and quality. Dewing's Improved Blood Turnip is a a form of the latter and hardly to be distinguished from it. Long Smooth Red attains a mammoth size, but is not salable when the turnip varieties varieties are to be had.

The beet is a gross feeder and hence is at its best only in rich land. That it be tender it must be grown quickly and not sown too thickly in the row, nor delayed in marketing until it becomes too large and tough.

TABLE NO. 9—BEETS.

Variety.	No. days vegetating	No. days before marketable	Height of top in inches	Weight of six largest beets, ℔s. and ozs.	Estimated product per acre, bushels and ℔s.
Bastian's Blood Turnip	21	87	14	48..7	1,036..20
Eclipse	21	81	12	51..2	959..14
Dell's Flower Garden	20	...	17	36..2	1,040..20
Henderson's Pineapple	22	91	16	31..3	1,141
Bassano	19	89	19	42..6	1,131..8
Dewing's improved Turnip	20	90	17	22..1	1,020..7
Extra Long Dark Red	18	100	24	64..5	1,402..10
Long Dark Blood	20	100	27	67..10	1,321..9
Dark Red Egyptian	20	74	13	29..4	936..14
Hatch's Blood Turnip	21	80	19	32	1,041
Henderson's Dwarf Pineapple	20	93	14	24..1	902..7
Simons' Early	20	91	16	15..3	900

PEAS.

Our trial list of peas embraced thirty-one varieties. One hundred seeds of each kind were sown in well enriched soil, two inches deep and three inches apart; the rows were three feet apart, to facilitate horse cultivation. The varietiest hat produced the first edible pods were Cleveland Rural New Yorker and Henderson's Improved Daniel O'Rourke. McLean's Little Gem is nearly as early, dwarf prolific, and of excellent quality. There are too many round, early varieties, earliness being their only commendation. The following kinds stand about equal in point of earliness, flavor and productiveness: First and Best, Lee's Earliest, Hancock, Earliest of All, Express and Maud S.

Of the late kinds the most productive were Telegraph, Dwarf Champion of England, Hairs' Dwarf Mammoth; Bliss Abundance, of excellent flavor; Commander-in-Chief, quality very inferior; Horsford's Garden Pea, of the best quality, and Telephone; Brown's Dwarf Marrowfat is an American Marrowfat pea of inferior quality, but very productive; John Bull is an admirable variety, a late, dwarf wrinkled variety, of good flavor; Early Caracticus is identical with Daniel O'Rourke.

Peas, to be tender, must be grown rapidly, and this means that they must have the best of ground. The pea has a tendency to degenerate if the best care is not given to the selection of seed. By a careful selection of the earliest pods, and of those that are wrinkled most, an excellent strain can be secured that, will be sure to give satisfaction. Peas do not mix readily, so that new varieties can only be obtained by artificial crossing. Some varieties, as the Extra Early Kent and Daniel O'Rourke, have many synonyms, the value of which depends on the care with which the seed was selected.

The statistics shown in the table as to the relative productiveness of the different varieties planted would not fairly represent them at higher elevations, for the reason that all varieties of the pea grow and bear fruit the whole season, especially if the pods are picked off regularly. On the plains this applies only in cool summers; usually this plant behaves here as it does at lower elevations. The figures under each heading in the table show the average estimate in that particular, for the season, and conditions under which each variety was grown. Under that of quality we have graded the varieties from 0 to 10, which means perfect.

TABLE NO. 10—PEAS.

Variety.	Date fit for table	Average height of top, in inches	Average No. of pods per plant	Weight of 100 pods, in ozs.	Weight of peas in 100 pods, in ozs.	No. peas in 100 pods	No. days between planting and maturity	Quality
Laxton's Superlative	July 20	48	6	14½	8½	307	76	8
Pride of the Market	" 25	20	7	13	9¼	421	56	6
Dr. McLean	" 24	20	6	10½	8	302	74	8
Blue Imperial	" 23	48	17	18¼	7¾	341	80	9
Strategem	" 29	18	10	10	8¾	305	75	10
Laxton's Supreme	Aug. 1	48	10	9¼	7½	279	72	7
Fill Basket, late	July 23	24	9	10½	8¼	298	66	8
John Bull	" 27	36	4	8½	5	378	76	7
Minimum	" 10	14	8	11	8¼	300	60	9
McLean's Little Gem	" 17	13	8	11½	8¼	349	67	9
Blue Peter	" 5	8	7	11	10	388	60	8
American Wonder	" 5	10	8	13	10½	410	52	0
Telegraph	" 25	36	12	17	12	530	68	18
Early Telephone	" 20	36	7	19½	8½	520	59	9
Horsford's Garden Pea	" 24	30	10	14	5	400	60	0
Brown's Dwarf Marrowfat	" 20	40	16	14	7½	402	78	16
Dwarf Champion, early	" 20	24	9	16¼	12¾	400	70	7
Hair's Dwarf Mammoth	" 20	24	6	14½	10	404	70	8
Commander in Chief	" 20	60	12	10¾	9¼	604	70	8
Bliss Abundance	" 23	36	12	13¼	10	600	58	0
McLean's Premier	Aug. 8	44	8	9½	7¼	411	72	17
William Hurst	July 14	12	6	7	6¼	347	55	5
Maud S.	" 6	12	6	9¼	6	175	51	6
Lee's Earliest	" 6	12	7	10½	7	206	54	5
Hancock	" 6	18	6	9	7	210	54	5
Earliest of All	" 6	18	5	9¼	6½	220	54	7
Dan'l O'Rourke	" 4	24	8	10¾	7	264	52	6
Rural New Yorker	" 4	36	9	14	8	206	52	9
Express	" 4	14	5	8½	6	204	54	5
Caracticus	" 4	18	4	5½	3¾	200	54	5

CABBAGE.

Two hundred seeds of twenty-seven varieties of the cabbage were sown in the open ground in hills, allowing four seeds to the hill; the plants were thinned to one when large enough, and the thinnings transplanted, for comparison. The land was in excellent condition, as regards fertility, but its mechanical texture was too stiff. The cabbage loves a rather sandy loam, especially with irrigation, as it enables one to keep the soil sufficiently open around the stems of the plants without much hand labor. The essentials requisite to produce a good crop of cabbage are good seed, to be procured at almost any cost, a suitable soil and thorough cultivation.

Cabbage, potatoes and some other vegetables are much benefitted by deep and close cultivation as soon as they have taken root; later on the cultivation must be more shallow, but they at all times like to have the soil worked up close to the stem.

Of early cabbages the earliest were the Jersey Wakefield, Early Ox Heart, Early Wyman, Sugar Loaf, Early Etampes. The latter variety has several synonyms. It is very early, but the head is soft. Cannon Ball and Wheeler's Cocoanut are not acquisitions. Tourlaville, head conical, yellow heart, of no especial merit. Mohawk Giant was very badly mixed with several other varieties. Canajoharie, an early sort, but badly adulterated with a worthless cauliflower.

Of second early the best were Early Summer, Deep Head, Fottler's Brunswick, a solid, sure header, and a good shipper; Winningstadt, a solid, conical head; Schweinfurt forms a very large head, but soft; Early Flat Dutch, an excellent variety when true to type; Fiederkrant resembles the Winningstadt closely.

Of late sorts the most desirable were Late Flat Dutch, very large heads, an admirable variety; Stone Mason, of good quality heads of medium size, a good variety for family use; Large Late Berger needs considerable room, heads of large size, with many outer leaves; Marblehead Mammoth, a large growing variety, but not a sure header; American Drumhead Savoy is the product of a cross between the Drumhead and the Savoy; it is the best of the Savoy cabbages; the head is large, solid and of the best quality; Savoy cabbages are in flavor and texture much like the cauliflower; the leaves are wrinkled, heads solid and the quality is much improved by freezing.

The Red Dutch is an extremely hardy variety, slow to mature, but an excellent keeper.

The value of the different varieties of garden vegetables depends largely on the care exercised in selecting only the best specimens of each kind to grow for seed, for to plant seeds untrue to type is always an unprofitable business. Every person who raises garden crops should each year select some of the best formed specimens of such kinds as they can profitably grow from seed. Vexation in sowing impure seed can only be avoided in this way.

The insect enemies of the cabbage that are universally troublesome in Colorado are the black flea (*Haltica Strigdata*) and the Aphis. The first is readily driven off, if taken in time, by an application of dry coal ashes. The Aphis is only destructive to late cabbages, and then on quite poor land.

It is impossible to apply any remedy that can reach the fly, because of the many hiding places among the leaves. We have used salt in liberal quantities to plants affected, with the best results. Cabbage should be planted only on land rich enough to keep them doing their best at all times.

The following table gives statistics in detail:

TABLE NO. 11—CABBAGE.

Variety.	No. of plants	Per cent. vegetated	Per cent. true to name	Weight of six largest in lbs. and ozs.	No. days in which they are fit for market
Schweinfurth	100	64	89	110..4	126
Large Early York	100	72	90	22..7	123
Tourlaville	100	55	78	13..2	139
Fiederkraut	100	48	80	16..7	122
Early Drumhead	100	57	71	18..4	130
Wheeler's Cocoanut	100	61	84	12..1	123
Schweinfurth Quintal	100	79	84	72..1	130
Cannon Ball	100	68	72	18..2	120
Fottler's Brunswick	100	61	89	42..7	122
Stone Mason	100	42	70	39..2	135
Large Late Bergen	100	60	79	40..1	140
Green Glazed	100	42	64	......	.....
Marblehead Mammoth	100	71	73	111..7	137
Early Ox Heart	100	80	84	20..1	122
Improved Drumhead Savoy	100	81	78	18..8	133
Red Dutch	100	67	90	16..2	130
Early Deephead	100	59	71	24..1	127
Early Bloomsdale	100	61	84	65..2	125
Lee's Excelsior	100	80	79	24..2	115
Early Wyman	100	65	80	18..4	112
Sugar Loaf	100	60	74	19..2	121
Winningstadt	100	72	70	26..7	122
Early Flat Dutch	100	79	81	44..4	129
Mohawk Giant	100	61	41	37..3	139
Cano Joharie	100	62	32	22..4	130
Henderson's Early Summer	100	82	87	45..4	128
Early Bleichfield	100	85	82	22..7	131

CAULIFLOWER.

We planted one hundred seeds of ten varieties of the Cauliflowor, and one variety of Brocoli, in a moderate hotbed April 7th, which were transplanted to highly enriched soil May 16th.

The Snowball, Extra Early Erfurt Early London were the first to form heads. The first mentioned, when true to name, is the ideal type of this favorite vegetable; leaves short, and with the tendency to head up quickly very pronounced. Late and large growing kinds, as the Half Early Paris, occupy the ground too long, and even then in this climate are uncertain about heading. The Purple Cape Brocoli is also unworthy of cultivation, as it has failed to head for the past two seasons.

TABLE NO. 12—CAULIFLOWER.

Variety.	No. days vegetating	Per cent. vegetated	Average heighth of plants	Per cent. true to name	Weight of six largest	No. of days until fit for table
Snowball	8	71	20	61	24..7	118
Veitche's Autumn Giant	9	56	33	79	36..3	130
Walcheren	8	59	20	78	23..7	130
Lenormand's Short Stem	8	58	18	60	18..4	128
Large Late London	8	50	23	59	33..1	130
Early London	8	28	18	32	19..4	123
Half Early Paris	9	30	36	90	42	137
Algiers	9	41	32	82	28..2	142
Early Erfurt	7	52	18	70	23..5	130
Extra Early Erfurt	7	62	16	75	19..3	123
Purple Cape Brocoli	9	52	33	95	......	.....

MISCELLANEOUS.

SMUT ON GRASS.

The smut (*ustilago carbo*) frequently attacks the flower of grasses. Whole patches of moist meadows were covered with the black efflorescence of this fungus the past season.

Of the cultivated grasses the tall Oat grass (*Avhenatherum avenaceum*) was most affected, and next Johnson's grass; of the wild grasses, (*Panicum crusgalli*) so abundant everywhere, and (*Bromas secalinus*) were most affected.

ERGOT

Is a fungus that develops upon the grain of several members of the grass family; all are subject to it, both the cereals and those of the meadow. It has long been known to be very destructive on the continent of Europe to both man and beast. The mode of growth is about as follows: The spores (or seeds) become attached to the flowers of a grass and germinate, the filaments of the fungus penetrating the ovary of the seed and converting the interior into a mass of threads. Spores are soon formed on the surface of the grain for the perpetuation of the species; after this the grain increases to its full size, and in this stage such as reach the ground remain there till spring, and with favoring conditions undergo another change, and thus completes its round of life.

The quantity of ergot on the wild pasture the past season was astonishing. It was most prevalent on *Agropyrum glaucum* (blue grass); moist meadows in which this grass occurred in any quantity was literally black with it. It occurred also in quantity on the various forms of the three awned grass, on the wild Rye grasses, and at all elevations and sparingly on Red Top and Timothy.

The conditions favoring its growth are not well understood, but in a general way it has been noted that warm, moist conditions exactly suit the development of fungi in general. Ergot is observed to be much more abundant on moist meadows than on high, dry land, although we noticed it in abundance at an elevation of 9,000 feet, on the Giant Rye grass (*Elymus condensatus*).

The quantity of ergot may always be lessened by underdraining, which should ever accompany irrigation,and by cutting the crop early, before the ergot has had time to develop, for whatever tends to improve the pasture will soon mitigate the evils of ergotism.

SEED TESTS.

The work of last year in testing seeds was continued the present season. The kinds generally tested show a higher vegetative percentage than those of the previous year.

Commission seeds, it is gratifying to note, are about driven out of the market. The purchase of them at any time, by either the amateur or professional gardener, was a short-sighted economy, because experience every year demonstrates that none but such as are most carefully grown, and are of the highest quality, prove satisfactory in the end either to the buyer or the seller. From experience we know, too, that some seedsmen are not sufficiently careful to secure trueness to type, and at least comparative freedom from foreign admixtures in the seeds sent out by them. The best seed in the culture of any crop is indispensable to success. Good seed costs money to grow it, and this fact the gardener would do well to recognize in purchasing, for in this case at least, what costs most pays best in the end.

Table 13 shows results in a test of seeds of various ages. These seeds were tested last year, and show a loss of vitality with increased age. Orchard grass is an exception; its ability to vegetate was as good this year as last. Some or all of these seeds may be older than that given in the table; they, however, have been in our possession the length of time opposite each kind in the table:

TABLE NO. 13—TESTS OF SEEDS.

Variety.	Age of seeds—years.	Per cent. vegetated.	Where From.
Orchard grass	4	30	Hiram Sibley & Co.
Spinach	3	50	B. K. Bliss & Co.
Tomato, Trophy	3	30	D. M. Ferry & Co.
Johnson grass	2	20	Henry Lee.
Blue grass	4	3	B. K. Bliss & Co.
Meadow Fescue grass	4	3	Hiram Sibley & Co.
Carrot, Danvers	3	30	B. K. Bliss & Co.
Onion, Danvers	3	30	Peter Henderson & Co.
Turnip, Strap Leaf	3	50	Department of Agriculture.
Cabbage, Wakefield	3	48	Peter Henderson & Co.
Corn, Darling's	3	50	Peter Henderson & Co.
Celery, Boston Market	4	4	J. J. Gregory & Co.
Cabbage, Mohawk Giant	2	51	Mohawk Valley Seed Co.
Carrot, Scarlet Horn	2	48	Department of Agriculture.
Sweet Vernal grass	3	4	B. K. Bliss & Co.
Tomato, Conqueror	3	65	D. M. Ferry & Co.
Cabbage, Flat Dutch	4	35	Barteldes & Patch.
Meadow Fescue grass	5	...	B. K. Bliss & Co.

Table No. 14 shows results in testing seeds for vitality, in the greenhouse; over two hundred tests were made during the past year. The first column shows the number of seeds sown, the second the weight of seeds sown, in grammes, and the third the percentage of seeds vegetated:

TABLE NO. 14---SEED TESTS, CONTINUED.

Variety.	Number of seed sown..........	Weight of seed sown, in grammes..........	Per cent. vegetated..........	Where From
Cabbage, Bleikhfield..........	187	.6882	81	J. J. Gregory.
“ Flat Dutch..........	300	.1354	90	T. H. Davy.
“ Deep Head..........	300	.4652	82	J. J. Gregory.
“ Tourlaville..........	300	.1055	73	J. J. Gregory.
“ Early York..........	300	1.0568	82	D. M. Ferry & Co.
“ Marblehead Mammoth..........	300	.9267	90	J. J. Gregory.
“ Fotler's Brunswick..........	300	.5815	70	J. J. Gregory.
“ Fotler's Brunswick..........	300	.7710	84	Barteldes & Patch.
“ Early York..........	300	.5665	89	Henry Lee.
“ Jersey Wakefield..........	300	.5568	74	D. M. Ferry & Co.
“ Jersey Wakefield..........	300	1.0910	83	Peter Henderson & Co.
“ Jersey Wakefield..........	300	1.1142	83	Henry Lee.
“ Jersey Wakefield..........	300	.9564	82	Barteldes & Patch.
“ Cannon Ball..........	200	.3418	80	Barteldes & Patch.
“ Winningstadt..........	200	.9128	81	Barteldes & Patch.
“ Early Dwarf Flat Dutch..........	200	.3356	78	D. M. Ferry & Co.
“ Schweinfurt..........	200	1.3115	76	J. J. Gregory.
“ Tom Thumb..........	200	.4326	80	J. J. Gregory.
“ Late Flat Dutch..........	200	1.0764	90	Peter Henderson & Co.
“ Late Flat Dutch..........	200	.1354	92	Barteldes & Patch.
“ Lee's Excelsior..........	300	.8611	80	Henry Lee.
“ Filderkraut..........	300	.4782	72	J. J. Gregory.
“ Early Summer..........	300	1.0665	80	Barteldes & Patch.
“ Early Mohawk..........	100	.3362	48	Nellis & Co.
“ French Oxheart..........	300	1.0115	73	D. M. Ferry & Co.
Cauliflower, Le Normand..........	300	.8184	50	Hiram Sibley & Co.
“ Early London..........	285	.7320	70	Peter Henderson & Co.
“ Early Erfurt..........	200	.6612	69	Peter Henderson & Co.
Carrot, Scarlet Horn..........	300	1.0115	73	D. M. Ferry & Co.
“ White Belgian..........	300	.2765	72	Peter Henderson & Co.
“ White Belgian..........	300	.3377	70	Henry Lee.
“ Danvers..........	300	.4692	73	Barteldes & Patch.
Parsnip, Hollow Crown..........	300	.3067	74	Henry Lee.
“ Hollow Crown..........	300	.3880	68	Barteldes & Patch.
“ Hollaw Crown..........	300	.4021	56	D. M. Ferry & Co.
Turnip, White Strap Leaf..........	300	.3654	47	Department of Agriculture.
“ Cow Horn..........	300	.5522	71	Department of Agriculture.
“ Cow Horn..........	280	.5666	80	Colo. Agricultural College.
Beet, Eclipse..........	200	2.5074	80	J. J. Gregory.
“ Yellow Globe..........	100	1.1291	81	Barteldes & Patch.
“ Bassano..........	200	2.5429	80	Colo. Agricultural College.
“ Egyptian..........	100	1.2255	74	Peter Henderson & Co.

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TABLE NO. 14---SEED TESTS, CONTINUED.

Variety.	Number of seed sown	Weight of seed sown, in grammes	Per cent. vegetated	Where From
Beet, Yellow Globe	200	1.1624	72	Henry Lee.
“ Long Red	100	4.5752	70	Peter Henderson & Co.
“ Prize Mangle	100	1.1271	71	J. J. Gregory.
“ Eclipse	200	2.5074	70	Peter Henderson & Co.
“ Bastians	300	4.3353	83	Hiram Sibley & Co.
“ Long Red Mangle	200	4.3383	73	Hiram Sibley & Co.
Seakale, Beekman's	100	.3362	68	Barteldes & Patch.
Tomato, Mayflower	300	.9110	81	Peter Henderson & Co.
“ Favorite	300	.7264	80	Barteldes & Patch.
“ Favorite	300	.7267	90	Peter Henderson & Co.
“ Mayflower	300	.7360	70	D. M. Ferry & Co.
“ Essex Hybrid	300	.7818	77	Barteldes & Patch.
“ Trophy	300	.1786	64	Peter Henderson & Co.
“ Round Red Smooth	300	.6334	90	J. J. Gregory.
“ Paragon	300	.5586	79	D. M. Ferry & Co.
“ Gem	300	.7990	90	J. J. Gregory.
Grass, Sweet Vernal	300	.1896	53	Barteldes & Patch.
“ Meadow Fescue	300	.5323	74	Hiram Sibley.
“ Timothy	300	.1145	87	Hiram Sibley.
“ Tall Oat	300	.2832	90	Hiram Sibley.
“ Tall Oat	300	.9555	81	Hiram Sibley.
“ Tall Oat	300	9855	70	Hiram Sibley & Co.
“ Italian Rye	300	.4955	81	Barteldes & Patch.
“ Johnson	300	.1335	52	Hiram Sibley.
“ Johnson	300	1.1355	54	Henry Lee.
“ Johnson	300	1.0029	48	Barteldes & Patch.
Alsike	300	.1422	56	Henry Lee.
Alsike	300	.1740	72	Hiram Sibley & Co.
Common Millet	300	.5468	84	Barteldes & Patch.
Red Clover	300	.4585	75	Barteldes & Patch.
Large Red Clover	300	.8531	80	D. M. Ferry.
Alfalfa	300	.6569	91	Barteldes & Patch.
“ Utah seed	300	.6251	85	T. H. Davy.
“ Colorado grown	300	.5781	90	T. H. Davy.
“ Colorado grown	300	.6118	84	Barteldes & Patch.
“ California grown	300	.6703	80	Henry Lee.
“ Utah grown	300	.6528	82	Henry Lee.

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